CONTRACTUAL FORM AND PERFORMANCE IN THE NORWEGIAN BUS INDUSTRY 1986-96

SUBMITTED TO THE SIXTH INTERNATIONAL CONFERENCE ON COMPETITION AND OWNERSHIP IN LAND PASSENGER TRANSPORT

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ABSTRACT

The Norwegian public transport market has experienced a significant development over the last decade. Over this period the number of independent companies have declined from 220 to 83, the two largest groups have through mergers and buy outs achieved control over more than 40% of the market. The regulating regime has changes from net cost contracts based on historical concessions through negotiated contracts based on ”normalised costs” and ”efficiency agreements” to tendered contracts in some counties, so far based on full cost. During the same period the operating unit cost has declined by approx. 20%, the subsidy rate by approx. 1/3 from 37% to 24%, and production has grown slightly. To test hypothesises about factors affecting the cost level at company and county level we have collected accounting and production data for all the companies for the period 1986-96 Statistics Norway. This pooled time series – cross section data set is used to estimate the effect of contractual form, economy of scale and scope, subsidy level on cost pr vehicle km, controlling for factors as passenger density, route speed and urban area. The same data and variables are applied to test hypothesises of market efficiency measured by cost pr passenger km.

Background

Within the research project "Institutional and financial framework for the development of efficient and rational local transport", financed by the Research Council of Norway, the Institute of Transport Economics has carried out 4 different analyses focusing on:

- Restructuring of the bus transport industry (Carlquist 1998)
- International trends compared with the Norwegian development
- In-depth analyses of developments in 5 urban areas (Norheim and Carlquist, 1999)
- Development trends based on local and regional bus transport statistics (this working report)

Until the late 1960s subsidies for local public transport were very modest. In the 1970s, both the unit operating costs and subsidies in the bus industry increased sharply. On the other hand, fare revenues declined as a result of low fare policy and declined patronage following the sharp increase in ownership of private cars. Until 1981, the government granted subsidies on a net cost basis to operators operating on concessions given for an area or a single route. Up to 1986, the government transferred dedicated public transport subsidies to the county authorities.

From 1986 the county authorities have been free to allocate all their resources among their main responsibilities for public service: health care, secondary education and transport. From 1991, the transportation act introduced competitive tendering, and in the spring of 1994 the amendments passed the parliament. The act of transportation includes a clause giving the operators the right of redemption if more than 20% of their production is put out on tender within 1 year, or more than 50% within 5 years from the first tender. This clause is in action until year 2002.

At present approx. 2-3% of the route production is operated on contracts obtained after a competitive procedure. Except for the capital area of Oslo and the tendered contracts, all public transport is operated on net-cost contracts where the county authorities approve the fares and level of service. All operators are private right incorporated companies. Shareholders are either private, public entities or both. Except one tendered contract won by the French-owned Swedish company Linjebuss, all operators are still domestic.

Over the last 4-5 years, the industry has been subject to a sharp restructuring through mergers and acquisitions. At present, the two largest groups control 43% of the market and 37% of the buses; the 5 largest control 77% of the market and 63% of the buses (Carlquist 1998).

When the regional level (the counties) took over the full responsibility for local public transport in 1986, it was clear for the most innovative of the county councils that there was a lack of cost control in the sector. A system of "normalised cost", taking into account different types of buses, lines, and areas to serve, was developed and subsequently implemented as a basis for negotiated contracts in 12 of 19 counties in the period 1986-95 (Gaasland 1998).

After the potential competitive pressure was established in 1991, some counties negotiated new contracts with the operators, stating that specific cutbacks in operating costs and subsidies were to be achieved each year over a period of 3-7 years. If the conditions in these “efficiency agreements” were not fulfilled, the service would be put out on competitive tender.

At present, tendering is used for as little as 2-3% of the production. 3 counties have decided or have started to implement incentive-based quality contracts in a net cost regime (for Oslo, see Norheim’s paper).

Hypotheses

A number of hypotheses have been formulated, regarding performance in the bus industry as an effect of changes in the legal framework. To test these hypotheses, it is necessary to control for a number of background variables such as economies of scale and scope, ownership and other factors affecting the operating conditions. The analyses are based on available data for the period 1986 to 1996.

Legal and contractual framework

At the local level, the hypotheses formulated are:

- The implementation of «normalised cost» contracts has contributed to significant reduction in operating costs.
- The implementation of efficiency agreements has contributed to significant reductions in operating costs.

At the national level, the hypotheses are:

- The possibility for competitive tendering has put more pressure on operators to reduce cost, i.e. there is a shift in trend regarding operating costs from 1992.
- The level of subsidy affects cost as a consequence of weak cost discipline, i.e. the higher the subsidy rate, the higher the operating costs.

Economies of scale, ownership and alliances

Earlier works suggest that there are modest economies of scale in local bus operation. Several works indicate that the unit cost to operator curve is convex. Berechman (1993) surveyed several studies; Solvoll (1995) analysed Norwegian data for two different years and found similar indications.

The following hypothesis has been tested:

- The unit-cost to operator size relation is convex

There has been a significant restructuring of the industry during the 1990s. The state-owned NSB Biltrafikk A/S (a subsidiary of the Norwegian State Railways) is one of the most important actors, and has acquired several companies mainly in the period 1993 to 1998.

Our hypothesis is that companies in the NSB group thus have lower operating costs than other operators.

Economies of scope

Several companies have been involved in other transport services than licensed local public transport. This includes e.g. goods transport, unscheduled coach services, and lately long distance coach services. Such multi-service production might gain the cost efficiency since use of drivers and vehicles for different purposes could improve utilisation of resources. We have proposed two hypotheses:

- Companies that also operate goods transport have lower costs in passenger transport than others.
- The cost in passenger transport is lower, the smaller proportion in company passenger transport that is subsidised transport.

Background variables - operating conditions

In most productive activities there is a long-term **trend** towards more efficient production of goods and services. This should also apply to public transport services.

Local conditions should have significant effect on the level of operating costs. Operating speed is a key variable since the heaviest component of cost is the drivers' wages.

Urban areas have at least some congestion leading to reduced operating speed. The distances between stops are short. This leads to higher driver costs and costs to fuel and maintenance of the vehicle. The larger the urban area is, the larger is the proportion of the route kilometres run during rush hours. This leads to higher costs because a larger proportion of vehicles only are operated for 1-3 hours daily, and the drivers have to be paid for a longer period than they are actually driving.

We have divided the urban areas in three groups, in order to test whether this affects unit cost:

1) The Oslo region: 900,000 inhabitants
2) Bergen, Trondheim and Stavanger: 150-230,000 inhabitants
3) 7 other cities with more than 50,000 inhabitants

Coastal areas have limited accessibility due to limited road infrastructure. The road network is connected with ferries, bridges or tunnels with tolls. This might increase costs indirectly through operating conditions or directly through the tolls that have to be paid. Our hypothesis is that companies that have expenses to tolls and ferries have higher costs (exclusive of tolls and ferry fees) than other does.

Traffic density measured by boarding passengers per vehicle kilometre. The more boardings/alightings there is on a route, the higher is the cost due to vehicle maintenance, support, ticketing, fuel consumption etc.

Data

For each financial year the bus operators have to submit to the Central Bureau of Statistics a detailed description of their operating costs and use of labour, fuel, tyres, rolling stock etc. Number of passengers, passenger km, fare revenue and subsidies are also reported.

The unit of report is company activity within a county for the years 1986-96. For the earlier years this is straightforward and correct. Since 1994, the mergers and acquisitions at national level have accelerated. Companies operating in several counties either report their activity in each county, or only in the county of their head office.

We have carefully examined the database to identify outliers and inaccurate information. A number of records were missing variables important for an analysis of productive efficiency, to estimate a cost function defining the relation between unit costs of production and prices and quantities for the input factors. Input prices are not reported explicitly, but in principle they can be calculated by dividing the reported quantities by the reported cost of input. The accuracy of data for important factors of input appeared to be weak. Size of rolling stock is an example of a variable that we had to reject to use for the analysis. An attempt to estimate translog cost functions (Viton 1998, Matas and Raymond 1998) with labour, fuel and capital as input factors had to be rejected because 3/5 of the observations missed either at least one of these factors or factor price.

Total number of operators and remaining operators in the database after rejection resp. vehicle km is given in table below.

Table 1: Description of database

Year	Operators			Mill Vehicle km's			1000 vehicle km/operator			
	Total	Used	% Excl.	Total	Used	% Excl.	Total	Used	Speed	Cost km
1986	327	300	8 %	310.2	304.5	1.8 %	949	1015	18.9	100.0
1987	289	262	9 %	318.2	311.0	2.2 %	1101	1187	19.2	98.3
1988	311	289	7 %	319.1	318.3	0.3 %	1026	1101	19.7	95.5
1989	243	236	3 %	318.3	311.8	2.0 %	1310	1321	19.3	93.6
1990	235	227	3 %	313.7	313.0	0.2 %	1335	1379	20.0	93.3
1991	203	194	4 %	310.0	302.9	2.3 %	1527	1561	20.5	92.3
1992	209	202	3 %	312.8	300.3	4.0 %	1497	1487	21.1	88.6
1993	205	195	5 %	327.3	313.4	4.2 %	1596	1607	21.7	86.6
1994	189	178	6 %	337.1	318.0	5.7 %	1784	1787	21.4	85.7
1995	166	156	6 %	320.4	296.4	7.5 %	1930	1900	21.4	82.9
1996	163	138	15 %	324.9	281.2	13.5 %	1993	2038	21.9	82.5
Total	2540	2377	6 %			4.0 %				-17.5

After exclusion of observations with missing or obviously incorrect variable values 2,377 observations (operator * year) of a total of 2,540 records in the database remained. This equals 94% of operators * year, and 96% of total vehicle km production over the period. Average production per operator is doubled during the period. As the "used" columns indicate, there has been a decline in proportion of reliable data.

Model estimation

Functional form

To capture non-linear relations among the variables, handle continuous variables that might be "0", obtain simple interpretation of parameters and a simple estimation procedure, we specified a combined log-linear exponential cost function by:

1) $$\ln Y = C + \sum_{i=1}^{I} \alpha i * \ln Xi + \sum_{j=1}^{J} \gamma j * Zj + \sum_{k=1}^{K} \beta k * Dk$$

where	Y	cost NOK/vehicle km 1996 prices
	C	constant
	Xi	continuos variable >0, nr i
	Zj	continuos variable [0 , 1] nr j
	Dk	dummy variable nr k, =1 if yes. =0 if no,
	$\alpha i, \gamma j, \beta k,$	parameters to be estimated

Interpretation of parameters: The elasticities, the relative change in Y by a marginal increase in a variable, can be written:

$$\varepsilon Xi = \frac{\partial Yi}{\partial Xi} * \frac{Xi}{Yi} = \alpha i * Xi^{\alpha i-1} * e^{\sum_{j=1}^{J} \gamma j * Zj + \sum_{k=1}^{K} \beta k * Dk} * \frac{Xi}{Yi} = \alpha i$$

$$\varepsilon Zj = \frac{\partial Yi}{\partial Zj} * \frac{Zj}{Yi} = \gamma j * Zj$$

$$\varepsilon Dk = \frac{\partial Yi}{\partial Dk} * \frac{Dk}{Yi} = \beta k * Dk$$

Description of variables

X1	Operators' annual production of vehicle km in passenger transport
X2	$(X1)^2$
X3	Time running from 1986=1 to 1996=11
X4	Time, years after tendering allowed 1992=1 to 1996=5
X5	Speed (Vehicle km/ paid driver hours)
Z1	Proportion of operators' production that is subsidised
Z2	Proportion of operators' revenue that is subsidies
Z3	Boarding passengers pr vehicle km
D1	If efficiency agreement =1, if not =0
D2	If normalised cost =1, if not =0
D3	If goods transport =1, if not =0
D4	Operator is NSB or subsidiary =1, if not =0
D5	Operator in Oslo/Akershus county =1, if not =0
D6	Bergen, Trondheim, Stavanger =1, if not =0
D7	Operator in other city >50 000 inhabitants =1, if not =0
D8	Expenses to ferry or toll road =1, if not =0

Estimation results

The central hypotheses relate to contractual form and impact on overall efficiency in the industry, and not which individual company that is most efficient. Therefore, we found Weighted Least Squares (WLS) estimation with operator's production of vehicle kilometers as weights, to be the most appropriate method. Estimations were done by the programme package SPSS.

The estimated parameters are reported in table 2.

Table 2: Estimated parameters

		LnY		lnV		LnP	
		Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
C	Constant	2.8864	25.067	1.6161	4.162	0.1387	2.647
1	Ln(km)	0.2133	7.728	0.1088	1.181	-0.0446	-3.569
2	$(Lnkm)^2$	-0.0134	-7.297	-0.0138	-2.241	0.0028	3.364
3	Time 86-96	-0.0233	-3.309	-0.0010	-0.044	0.0102	3.211
4	Time: 92-96	-0.0196	-2.491	0.0342	1.293	0.0089	2.484
5	Speed	-0.3217	-19.371	-0.5257	-9.260	0.0154	2.022
1	Prop. subsidised	0.0193	0.913	0.9838	12.802	-0.0441	-4.599
2	Prop. subsidy	-0.1272	-6.236	-0.5009	-7.186	0.0845	9.064
3	Boardings/km	0.1063	18.246	-0.3438	-14.794	-0.0144	-4.790
1	Eff. Agreement	0.0272	2.334	0.0674	1.679	-0.0031	-0.566
2	Norm. Cost	-0.0382	-5.059	-0.0962	-3.830	0.0091	2.659
3	Goods =1	-0.0119	-1.624	0.1041	4.272	-0.0127	-3.817
4	NSB =1	-0.1050	-9.330	-0.1613	-4.272	-0.0051	-0.993
5	Oslo + =1	0.1788	14.211	1.0527	23.061	0.0318	5.372
6	Large city =1	0.0320	3.226	0.0322	0.963	0.0226	4.967
7	City>50000 =1	-0.0622	-5.190	-0.0234	-0.586	0.0156	2.878
8	Ferry/toll =1	0.0262	2.811	-0.0279	-0.861	0.0002	0.039
		0.188		0.38		0.044	
R^2		0.555		0.371		0.095	

Y= Cost NOK/vehicle km
V= Cost NOK/passenger km
P= Profit ratio

Of the 17 estimated parameters, 15 are significant at the 5% level given a 2-tailed t-test, while 1 (β3) is significant by a 1-tailed t-test. The R2 value of 0.555 indicates that our model explains more than 55% of the variation in cost among operators over the years examined. This can be considered as satisfying, since major cost determinants at operator level are left out from the model by reasons noted above.

Examination of the residuals indicates that their variance is constant and that the residuals not are correlated to unit cost.

Interpretation of results

Background variables

The general trend variable shows a decrease in unit cost of 6.3% over the period. “Drivers’ speed” is as expected an important variable, the cost elasticity is above 0.32.

Ferries or toll roads have significant influence on unit cost. Operators operating in such conditions are expected to have 2.6% higher unit cost (exclusive of ferry and toll expenses) than others do.

Urban conditions imply higher expected unit cost. Operators in Oslo and Akershus County are expected to have nearly 18% higher costs than companies operating under the same conditions in other counties. The 3 “second largest” cities, Bergen, Trondheim, and Stavanger are expected to have on average 3.2% higher unit costs. Operators in the smaller cities ranging from 50-150,000 inhabitants, are expected to have 6% costs. These findings are clearly significant. The explanation for this might be as noted above that the proportion of extra rush hour vehicle km’s to total vehicle km’s is lower than in other areas.

Passenger density, i.e. number of boarding passengers per vehicle km has significant influence on unit cost. $\gamma 3 = 0.106$ means that unit cost increase by 1% if the number of boarding passengers increases by 10% from 1 to 1.1 per vehicle km. The value of 1 is relatively close to the national average.

Economies of scale

The operator size variables (a1, a2) indicate that the unit cost increases with the number of vehicle km’s until approx. 2.8 mill km/year (exp(-a1/2*a2) = 2.8 mill km/year) and decreases slightly for larger operators. This in opposition to a number of other studies showing convex curves. Possible explanations for this are that we are controlling for several background variables that might be related to size. One that might be important in this context is the trend variable that shows high significance and the fact that there has been considerable company concentration during the period. However, we ran the same model specification separate for each year to investigate this. We found $a1>0$ and $a2 < 0$ for every year, but the parameters were significant only for 6 of the later years.

Earlier analyses both on Norwegian and international data indicate that there are economies of scale in production of bus route km’s up to a certain level (U-shaped cost curve with respect to size of company) (Solvoll, Jørgensen and Pedersen 1994, Matas m fl 1998, Berechman 1993, Dale-Olsen 1996). The massive restructuring of the European bus industry both at national and at the international level is another indication of economy of scale.

However, the question of economies of scale can be seen from two angles:

- Production: is it more efficient to operate a company with a large production than a company with a small production?

- Market: is it more efficient for users to relate to few but large company units with uniform information, fare system, integrated network of routes etc, than small and independent companies?

Carlquist (1998) anticipated two motivations for this:

- Strategic economies of scale; benefits from competence and power with respect to negotiating contracts for purchase of fuel, buses, spare parts, service agreements toward the suppliers of material and contracts with the authorities. Another aspect of such economies of scale is know-how with respect to information technology, administrative solutions, benchmarking, quality management and the transport market.

- Market power in certain areas to maintain the market share in a situation where future competitive tendering is expected.

For many counties, there has been a tendency towards only one large operator dominating in each county. These operators (incl. subsidiaries) have a unit cost more than 10% below the others, everything else being equal.

Economy of scope

Operators running other than subsidised passenger transport do not tend to have lower costs. The parameter ($\gamma 1$) is positive but not significantly greater than zero. Operators running both passenger and goods services have slightly lower operating costs in passenger transport than other operators. This is significant on a one-sided test, but an expectation of 1.2% lower costs, everything else equal, is quite low.

Legal and contractual framework

Efficiency agreements do not contribute to reduce costs, according to the results. On the contrary, operators with such agreements tend to have nearly 3% higher cost than other operators. This is surprising, but one explanation may be that such agreements are quite new, and that they in effect are chosen as instruments in counties where costs are presumed to be higher than they “should be”. Since this form of agreement is new, it could take a few more years before they have the planned effect. On the other hand, it may be argued that these agreements are too weak to offset the general trend of more efficient public transport.

The normalised cost contracts give at average nearly 4% lower cost than the other contracts do. Compared to the efficiency agreements the difference is 6.5%. An explanation for this might be that the operators' incentives to reduce cost under the normalised cost contracts are stronger, since this can contribute to increased profit, whereas the efficiency agreements are normally related to reduced subsidies.

The trend factor from 1992 is significantly stronger than for the whole period. This can approve the hypothesis that the legal opening for the counties to put the operation out to competitive tendering lead to increased cost discipline among the operators.

The subsidy to cost rate is significantly negative. $\gamma 2$ = -0.13 has the interpretation that a 100% subsidised operator's unit cost is 13% *lower* than that of a non-subsidised operator. The interpretation of this result is important for policy makers; the subsidies cover low fare revenue caused by either low fares or low patronage and *not to cover operational losses due to high cost*.

Cost per passenger km

This analysis shows that there is no significant trend regarding reduced cost per passenger km. The explanation behind this is quite simple; there has been a significant decrease in patronage. This might be a result of more focus on reducing subsidies and cost pr km in the period rather than delivering better quality service at a reasonable price to the users. The parameters for efficiency agreements and normalised cost contracts have the same signs as for cost per vehicle km, but with more weight on normalised cost contracts. This indicates that operators in the normalised cost contract regime at average have higher patronage than other operators do.

Profitability

Profitability has improved significantly over the period. The estimated parameters indicate that small and large operators tend to have higher profits than the mid-size operators do. Profitability is significantly higher in urban areas than in other areas. Profitability in passenger transport is significantly lower for operators also involved in goods transport. On the other hand, companies with a larger proportion of subsidised company passenger transport have higher profitability than companies with a lower proportion of subsidised transport.

Concluding remarks

We have found significant indications for a trend towards reduced cost in the Norwegian bus industry over the period studied. This can partly be explained by the potential, but not yet actual, competitive pressure from the legal opening for tendering. Contractual forms have influenced cost through both efficiency agreements and normalised cost based contracts. Low revenue from fares, rather than high costs, determines the level of subsidy.

The collection of official data for the public transport sector should be more concentrated on market data and less detailed on production data as the accuracy of relevant variables suffer from the mass of data collected with questionable quality. The production side should at least contain some information of the route structure such as line kilometers covered and vehicle kilometers divided by peak and off-peak hours.

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